Space Weather Technical Forecast

Issued on Wednesday, 03 July 2024 at 01:22 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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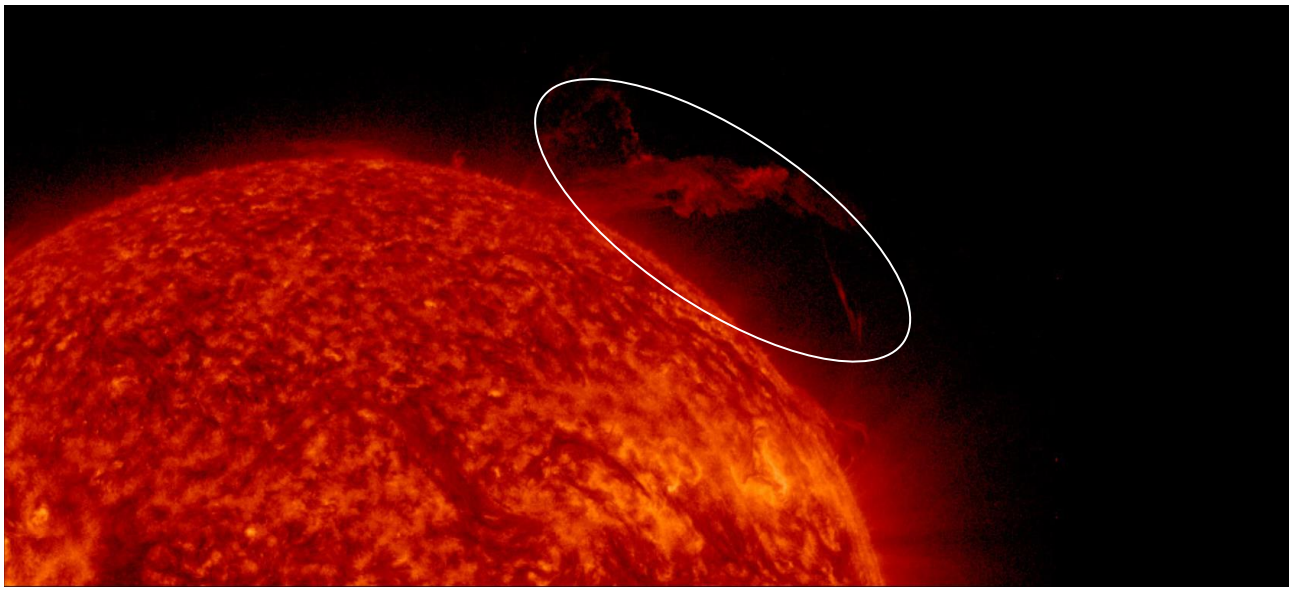
Space Weather Forecast Headline: Chance of M-class flares throughout. Chance of G1/G2 Minor/Moderate storm intervals Days 1 (03 Jul) due to CME influences.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Low in the last 24 hours with just C-class flares. There are currently fifteen regions on the disc, the majority of which are small and simple. AR3729, near south-centre disc, is currently the largest and most complex region on the disc. A small delta spot recently emerged on its leading part but its trailing part, which consists of multiple small spots, seems to be slowly fading. To the north of AR3729 is AR3733 which is developing in complexity and size. It did lose its trailing spot but gained a new intermediate spot with penumbra. AR3734, in the northeast quadrant, is very elongated but rather small in areal extent and simple in terms of magnetic complexity. However, it recently showed a proliferation of intermediate spots and remains one of the main players. The region which was responsible for the Moderate-class flare on 01 July has declined.

A large filament was observed lifting off the sun's surface in the northwest at around 02/1915 UTC. There is no coronagraph imagery available at the time of writing but it is highly likely that a CME will be observed; we will endeavor to run an analysis as soon as possible.

Figure 0. SDO-aia Channel 304 from 02/2009 UTC showing the large arc of plasma erupting at the surface of the sun.



The CME that was observed after the M2.1 flare on 01 July (from AR3730 in the southwest quadrant) has been reassessed and is now considered most likely to miss ahead of Earth's orbit

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on 05 July. No other Earth-directed CMEs have been observed in imagery during the past 24 hours.

Solar Wind / Geomagnetic Activity: Solar winds observed by ACE at L1 have been those of a slow regime. Solar wind speeds have been slowly declining from 430 to 370 km/s with a below average density. The Interplanetary Magnetic Field, Bt, was weak throughout, below 3nT. The north-south component, Bz, varied weakly between +2/-3nT. Phi angle has been predominantly positive (away from the Sun). Geomagnetic activity was Quiet (Kp 0-2).

Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux observed by GOES18 remained at background levels. High energy electron flux (greater than 2MeV) observed by GOES16 fluctuated between background to moderate levels with a peak of 641pfu at 02/1720 UTC. The 24-hour fluence remained below Active on a rising trend, with 1.79e7 integrated pfu observed at 03/0000 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Low activity is likely to continue, with a chance of isolated M-flares.

Solar Wind / Geomagnetic Activity: The large CME that was observed leaving the Sun on 29 June may give Earth a glancing blow on Day 1 (03 Jul). A second CME which left the Sun on 01 July has been re-assessed and is now considered to be passing ahead of Earth. There are no significant coronal holes on the disc to give any fast wind influence.

Geomagnetic activity is expected to be generally Quiet to Unsettled (Kp 1-3), with a chance of Active to G1/Minor storm (Kp 4-5) intervals and a slight chance of G2/Moderate storm intervals (Kp 6) on Day 1 (under CME's influence), however confidence is fairly low. Returning to mostly Quiet to Unsettled conditions during Days 2 to 4 (04-06 Jul).

Energetic Particles / Solar Radiation: High energy proton flux is expected to remain at background levels. However, there is a very slight chance of exceeding the S1/Minor Storm threshold should any notable flares occur. High energy electron flux has shown an increasing trend after the recent CME influence. A similar enhancement may well occur after the expected CME arrival but confidence is low and the most likely outcome is for the electron flux to remain at background or moderate levels. The associated 24-hour fluence is likely to remain below the Active threshold, albeit with a slight rising trend.

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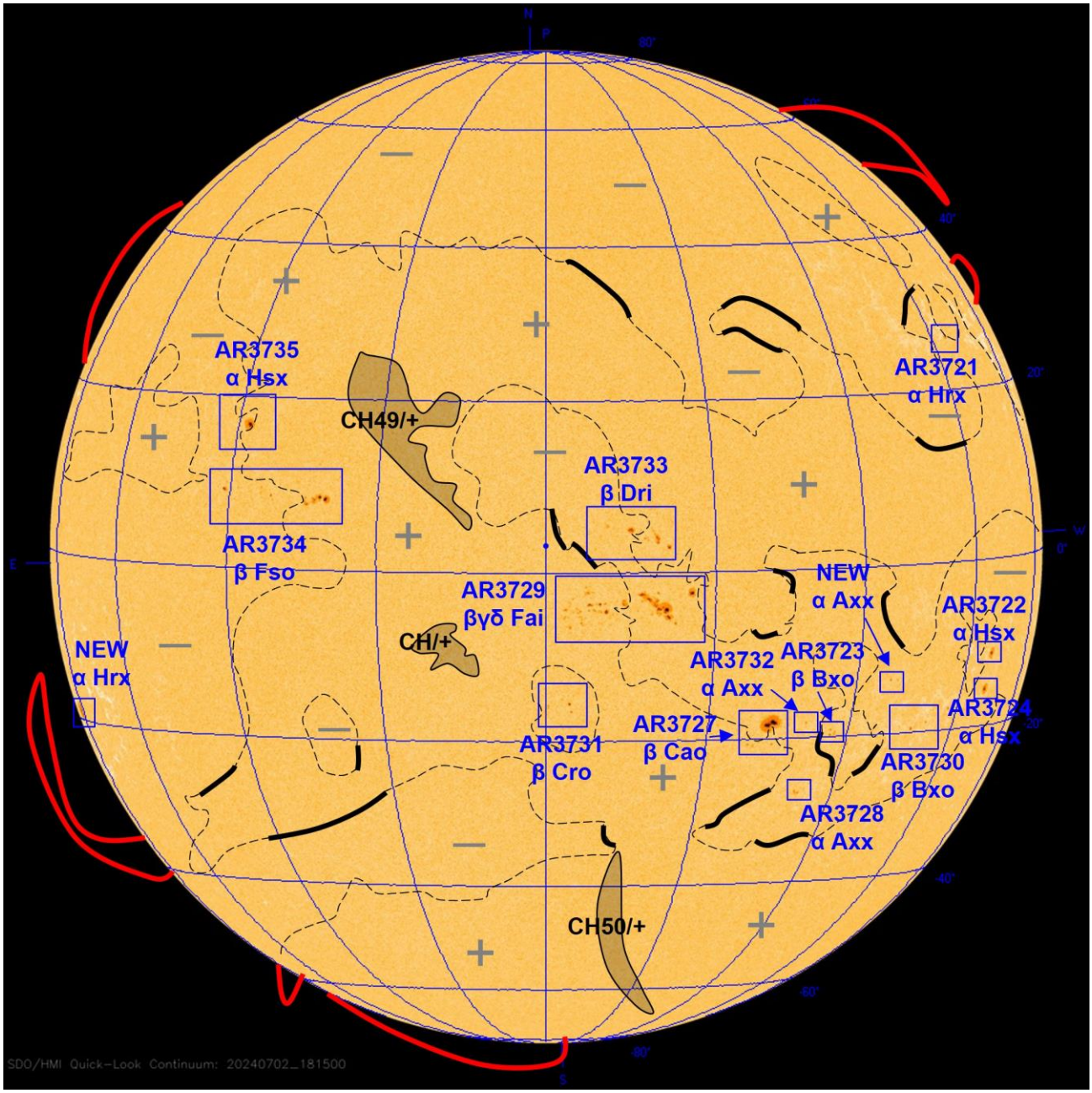
Figure 1. Solar Analysis Valid 02/2000 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Met Office Space Weather Technical Forecast

Geomagnetic Storms:
A large filament lift-off was observed around 29/1530 UTC in the southwest, followed by a CME visible on coronagraph imagery. Analysis suggests a glancing blow on Day 1 (03 Jul), however confidence is low. The bulk of the ejecta is expected to be passing below Earths orbit, resulting in a limited impact on the solar wind speed. Enlil suggests a rise of around 50 km/s, taking the solar wind from slow-ambient to slightly elevated at best.

The CME associated with the M2.1 impulsive flare from AR3730 in the southwest at 01/1102UTC has been re-assessed and is now considered to be passing ahead of Earth. There are no significant coronal holes on the disc to give any fast wind influence.

Geomagnetic activity is expected to be generally Quiet to Unsettled (Kp 1-3), with a chance of Active to G1/Minor storm (Kp 4-5) intervals and a slight chance of G2/Moderate storm intervals (Kp 6) on Day 1 (under CME's) influence, however confidence is fairly low. Returning to mostly Quiet to Unsettled conditions during Days 2 to 4 (04-06 Jul).

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	30	5	1	1
Strong	G3	No	5	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
29/2010	Partial	Filament	SW	780 km/s	03/0000 UTC +/- 12 hrs	Glancing blow likely, timing uncertain

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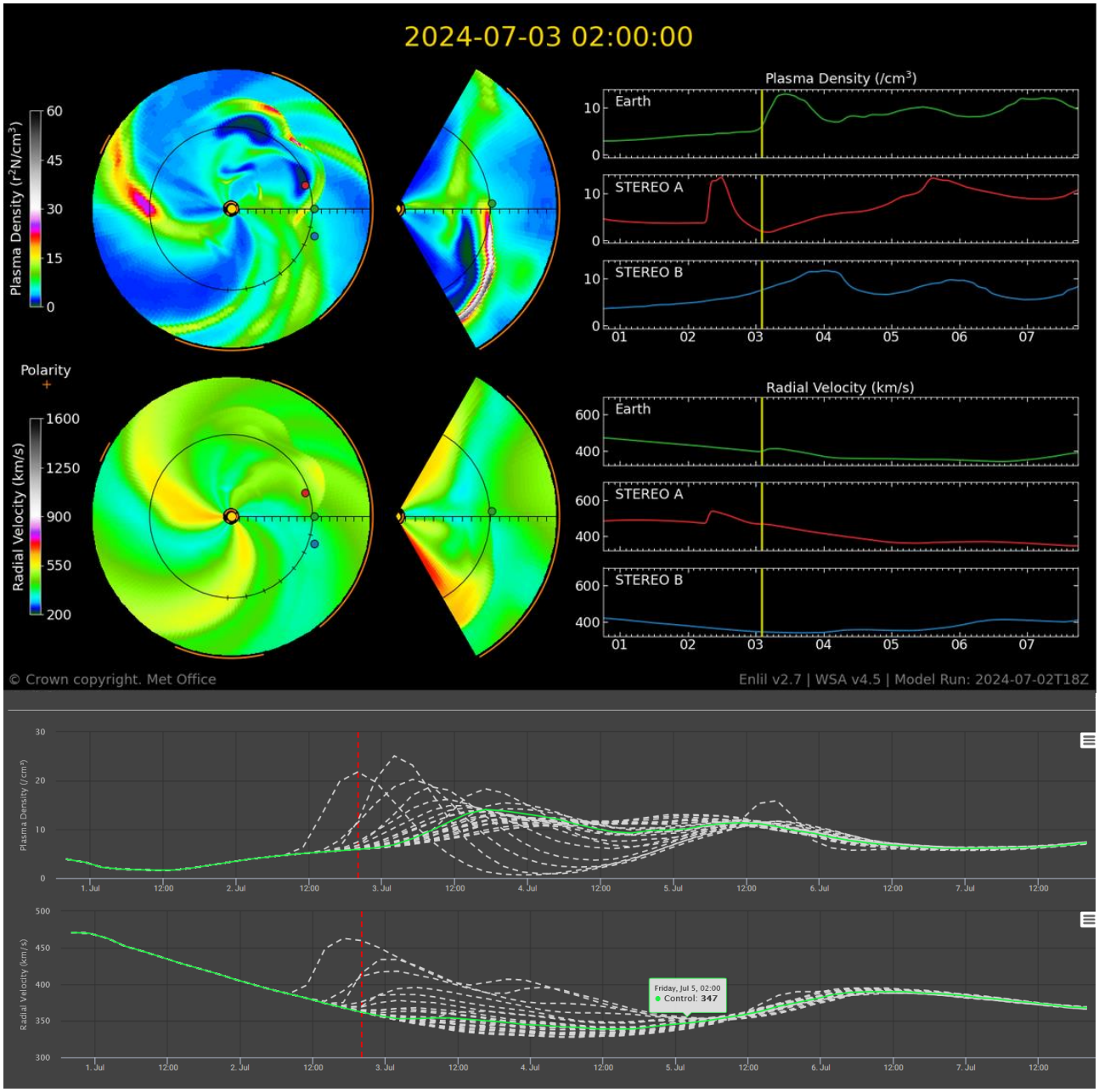
Figure 2: MOSWOC Enlil and Ensemble, showing potential CME arrival.



Radio Blackouts - X-Ray Flares:

There are currently fifteen regions on the disc, the majority of which are small and simple. AR3729, near south-centre disc, is currently the largest and most complex region on the disc. A small delta spot recently emerged on its leading part but its trailing part, which consists of multiple small spots, seems to be slowly fading. To the north of AR3729 is AR3733 which is developing in complexity and size. It did lose its trailing spot but gained a new intermediate spot with penumbra. AR3734, in the northeast quadrant, is very elongated but rather small in areal extent and simple in terms of magnetic complexity. However, it recently showed a proliferation of intermediate spots and remains one of the main players. The region which was responsible for the Moderate-class flare on 01 July, AR3730 in the southwest, has declined.

A new region has recently emerged onto the southeast limb. It currently consists of a single spot but its classification is likely to change once it rotates fully on to the visible disc.

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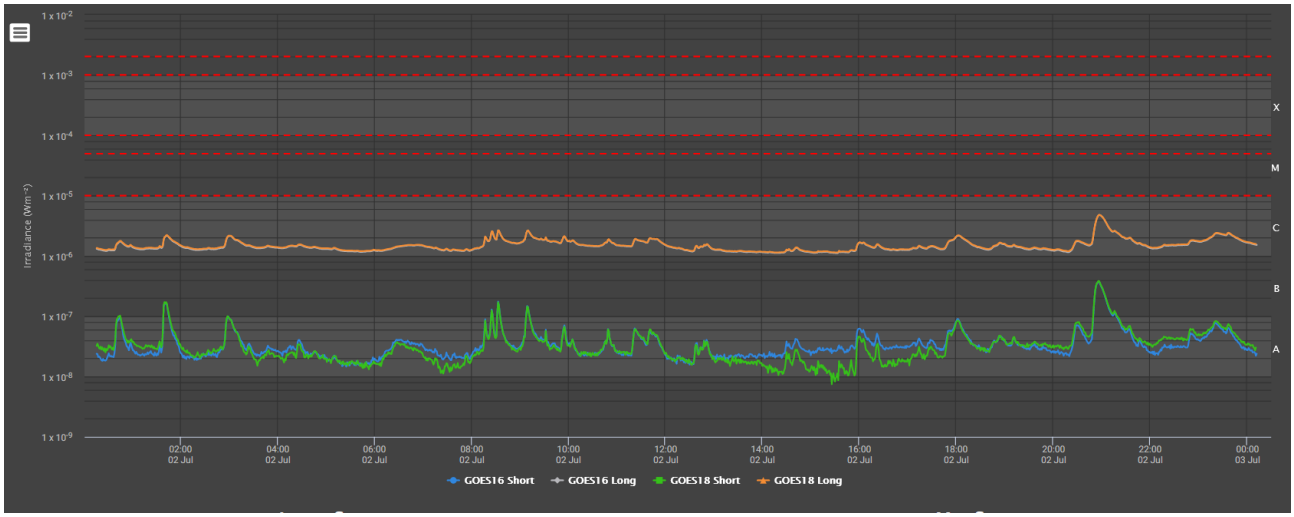
Each individual region only contributes a small amount to the overall flare risk. Overall, the flare risk has been kept flat throughout with a chance of isolated M-class flares, and a very slight chance of X-class flares.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	40	40	40	40
Very Active	R3 to R5 X Class	No	5	5	5	5

Figure 3: Latest X-Ray flare activity, as observed by GOES 16/18



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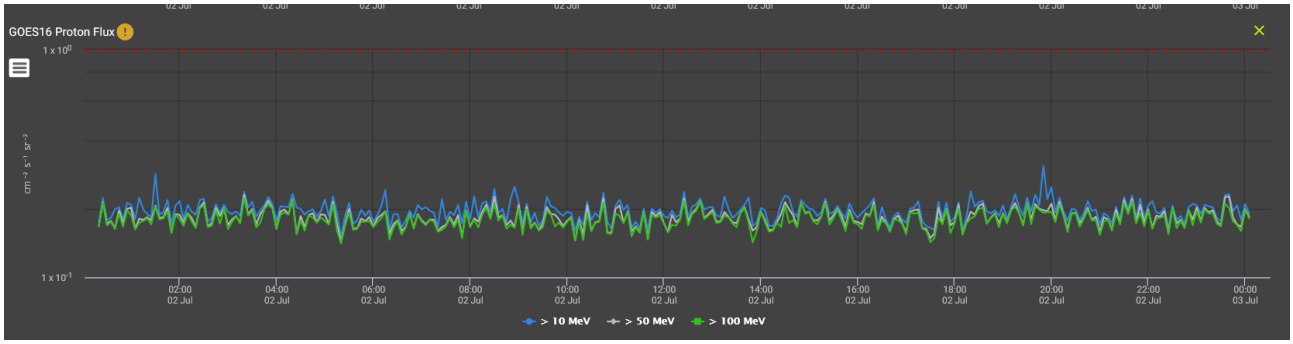
Solar Radiation Storms - (High Energy Protons):

High energy proton flux, as measured by GOES-18, is most likely to remain at background levels. Despite a large amount of sunspots on the Earth-facing disc, they are relatively small and magnetically simple, making proton enhancements unlikely.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	5	5	5	5
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Figure 4: Latest Proton flux, as observed by GOES16



High Energy Electrons Event (≥ 2MeV):

High energy electron flux, as observed by GOES-16, has been at background to moderate levels over the last 24 hours, peaking at 641pfu at 02/1720 UTC. This was due to the relaxation of the Van Allen belts following the recent CME enhancement. Another potential source of enhancement lies in the expected arrival of a CME on Day 1 (03 Jul). However, confidence is low with regards to the impact and the most likely scenario at present is for the electron flux to remain at background or moderate levels, with perhaps a slight rising trend.

Should the impact materialise, there will most likely be a rise in the electron flux after a day or two. This would probably take it to high levels but the associated electron fluence is currently so low that it would take several days for it to reach the Active threshold.

Associated electron fluence is most likely to persist below the Active threshold (1e8 integrated pfu), but with just a slight chance of an increase above Active. MOSWOC REFM is forecasting a below Active trend through the next three days, which reflects the most probable outcome.

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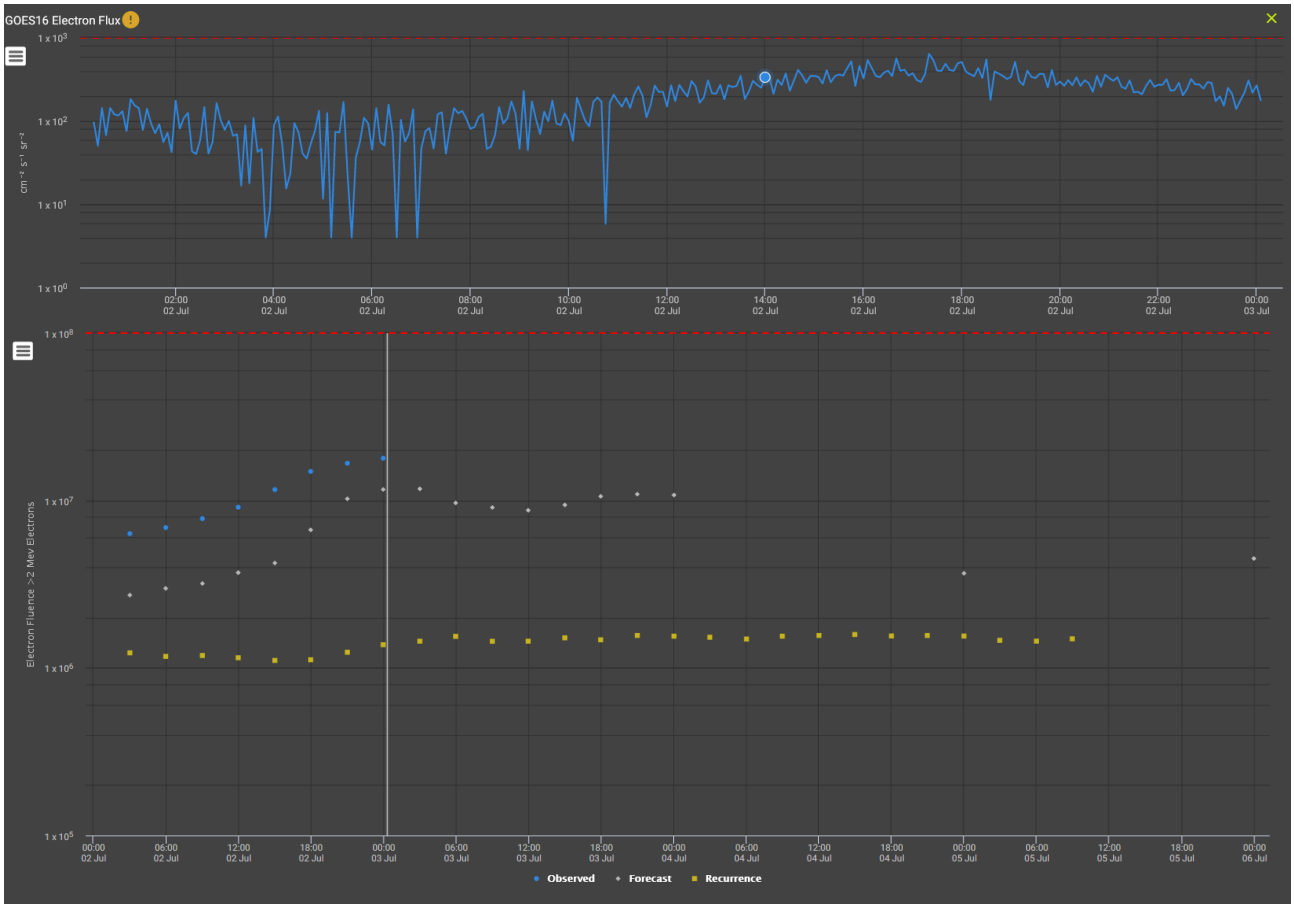
GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	5	10	20	30
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 5: High energy electron flux (top), as observed by GOES16, and MOSWOC REFM (bottom)



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